**How Soccer Can Help Us Understand Physics**

Sports provide a great way to understand physics. Physics, after all, is the study of matter and its motion through space and time. And since sports like soccer, swimming and cycling involve bodies moving through space, they can help us understand how the principles of physics work.

Imagine that you’re looking at a soccer ball on a grassy field. If you do nothing to the ball, it will stay motionless on the grass. If you kick the ball, it will roll along the grass before coming to rest again. Pretty simple, right?

For thousands of years, though, people thought that objects like this soccer ball come to rest because they have a natural tendency to stop. It took a famous physicist by the name of Sir Isaac Newton, who lived in the 1600s, to prove that this was not exactly correct.

Newton suggested that objects like the soccer ball have a natural tendency to keep moving. The only reason they stop, he believed, is because an unbalanced force acts on them. By an unbalanced force, Newton meant the force applied to the soccer ball by its environment. When kicked, the surface of the ball travels over the grass, creating friction. The taller the grass, and the rougher the surface of the ball, the more friction is created. And the more friction that exists between the ball and the grass, the less it will travel after being kicked.

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Now, imagine that there is no grass. Instead, the ball is resting on a frozen lake. When you kick the ball on the ice, the ball will go much farther than it would have on the grass. This is because ice provides a lot less friction than the grass.

Even so, ice does provide some friction. The ball’s interaction with the frozen water crystals on the surface of the lake eventually causes it to come to rest again. But now imagine that instead of ice, the surface the ball rests on has no friction at all. The ball is floating in a vacuum. If you remove friction entirely, kicking the soccer ball would cause it to keep going and going at the same speed, until some force caused it to slow down and stop.

To paraphrase Sir Isaac Newton,

a soccer ball on the grass will stay where it is unless acted on

by a force. Similarly, once you kick the ball, it will remain in motion unless acted on by force.

This, in so many words, is known as Newton’s First Law of Motion.

The same principles apply for other sports. Take swimming. Olympic swimmers are in a

constant battle with the force of water. Water wants to slow them down. To increase their

speed, swimmers often shave their entire bodies, reducing the amount of friction caused by

hair. Since a swimming contest can be won or lost by a tenth of a second, anything they can do

to remove friction will help—even if it means ridding your body of hair.

Recently, Olympic swimmers took to wearing full-body suits in the water, which made

swimmers sleeker and reduced underwater friction. Swimmers wearing these suits began to

break world records. They started winning all the races. Soon enough, Olympic officials,

realizing that these suits posed an unfair advantage, banned the use of suits in Olympic

competition. Swimmers had to fall back on their own, hairless skin.

The situation for professional cyclists is slightly different. Unlike the swimmer, who battles the

water, the cyclist is confronted with multiple forces that seek to slow him or her down: the

force of the road and the force of the air. Like professional swimmers, pro cyclists are known

to shave their body hair, to reduce the amount of friction caused by the wind. But the loss of

body hair represents only a tiny reduction in surface friction compared to, say, wearing

spandex shorts instead of baggy shorts with pockets that fill up with air as you ride.

To reduce friction and increase speed, cyclists adopt all kinds of techniques. They wear

aerodynamic helmets. They crouch low over their bikes. They wear shirts and shorts that cling

closely to their skin, preventing air from slipping inside and slowing them down. However,

little can be done about the tires’ interaction with the pavement. As in the case of the soccer

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ball, a bicycle wheel will eventually stop spinning if no force acts upon it to keep it moving. The

rougher the road, the sooner that bike wheels will come to a stop.

For this reason, cyclists tend to have large, bulging thigh muscles. These muscles allow the

cyclist to continue exerting force on the bicycle pedals, which cause the wheels to keep

spinning despite their constant interaction with the road. Of course, other factors come into

play, too. The heavier you are, the more work you have to do to keep the bike moving—that is,

unless you’re moving down a hill, in which case the gravitational force of your weight acts to

your advantage.

Also, your ability to keep your legs pushing the pedals depends on how fit you are, not just

how strong your legs are. Many people who are out of shape would run out of breath before

they complete a mile-long bike ride, whereas a person who is fit and has a lot of stamina could

travel two miles without much difficulty.

Whether you are in shape or not, what really matters when trying to kick a ball, swim a lap, or

bicycle a 5 mile race are the forces of physics. Without them, every time you kicked a soccer

ball or jumped on a bike, the ball and the bike would keep going, forever. After the initial

excitement, that wouldn’t be much fun at all.